**Before the**

# FEDERAL COMMUNICATIONS COMMISSION

**Washington, D.C. 20554**

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|---|---|---|
| **In the Matter of** | **)** | |
| | **)** | |
| **Expanding Flexible Use of the 3.7 to** | **)** | **GN Docket No. 18-122** |
| **4.2 GHz Band** | **)** | |
| | **)** | |
| **Expanding Flexible Use in Mid-Band** | **)** | **GN Docket No. 17-183** |
| **Spectrum Between 3.7 and 24 GHz** | **)** | |

## *EX PARTE* STATEMENT OF ROBERT BOSCH LLC AND SUPPORTING PARTIES

Robert Bosch LLC (Bosch), by counsel, for itself and on behalf of the Supporting Parties noted herein,[1] and pursuant to Section 1.1206(a)(1) of the Commission's Rules [47 C.F.R. §1.1206(a)(1)], hereby respectfully submits this *ex parte* statement to supplement the record in this proceeding, specifically with respect to the implementation of private, local 5G networks that facilitate advanced manufacturing in the United States. Bosch has previously submitted comments and reply comments in response to the *Notice of Proposed Rule Making*, FCC 18-91, released July 13, 2018 in the captioned docket proceedings (the *Notice*). In the continued interest of ensuring sufficient spectrum for private, local 5G networks to facilitate innovations in industrial manufacturing systems and in other flexible deployments of this mid-band spectrum, Bosch and the Supporting Parties would offer the following, additional information for the record.

[1] Bosch is authorized to note that the following companies, each of which is engaged in manufacturing activities in the United States, support the positions enunciated herein, and each is a signatory hereon: Ford Motor Company; Volkswagen Group of America; Sennheiser Electronic Corporation; Mercedes Benz US International; Endress + Hauser USA Automation Instrumentation, Inc.; Hirschman Automation and Control GmbH, and Beckhoff Automation GmbH. These companies are collectively referred to herein as "the Supporting Parties."

## I. Introduction.

1. 5G implementation worldwide is proceeding at a rapid pace. One reason for this is the expected benefit of 5G technology in numerous industry sectors (referred to as "5G verticals": markets in which goods and services are provided that are specific to an industry, trade, profession, or other group of customers with specialized needs). These sectors include transportation, media, and manufacturing – where integration of 5G into industrial communications is already being considered[2]. The information presented herein illustrates some of the progress in the implementation of private, local 5G networks, which stands to revolutionize manufacturing processes.

2. To compare factories of the past with near-future factories enhanced with 5G connectivity, the former were static, and of necessity were optimized for one particular product. "Industry 4.0" is the digital transformation of industrial operations towards flexible and almost unlimited optimization. In Industry 4.0 factories, the only fixed components are the floor, walls and ceiling. They have ubiquitous, wireless connectivity for plug-and-play and mobility, and 5G is the "central nervous system" for the entire factory. It connects rotating and moving parts; it includes mobile devices; it permits easy retrofitting; higher flexibility and versatility; leveraging of cloud computing; lower maintenance costs; decreased outages; and it permits accurate object localization. This transformation will be facilitated by (1) the availability of 5G technology; (2) adequate mid-band spectrum therefor; and (3) the implementation of a reliable communication layer capable of dealing with an increase of several orders of magnitude in the number of assets, volume, variety of information and reaction times in manufacturing systems.

[2] See 3GPP Technical Report (TR) 22.804, chapter 5.3 "Factories of the Future", https://portal.3gpp.org/desktopmodules/Specifications/SpecificationDetails.aspx?specificationId=3187

3. Local deployment by the private sector offers major promise in the rollout of 5G for Industry 4.0 initiatives in manufacturing and industrial applications. As is the case with today's Wi-Fi hotspots, the manufacturing industry would benefit greatly from the ability to manage its own individual 5G local networks without those networks being necessarily under the control of commercial mobile broadband service providers. Among the reasons for this are liability issues, early deployment, compatibility with incumbent, mid-band spectrum users, intellectual property protection, and security. For full realization of 5G capability, manufacturers should have the ability to deploy networks where and when they are needed, irrespective of the considerations or constraints of commercial mobile broadband service providers. Some Industry 4.0 applications of 5G can be supported using public mobile 5G broadband from service providers, while others cannot. Manufacturers require the flexibility to select the best option for 5G infrastructure according to their use-cases, timetables, schedules, geographic location and individual manufacturing needs.

**II. Private, Local 5G Networks will Enable American Manufacturing to Compete & Thrive in a Global Marketplace.**

4. There are two major trends being implemented worldwide at the present time. The first is Industry 4.0. The Fourth Industrial Revolution creates new ways for goods to be produced, shipped, and serviced throughout their entire lifecycle. It increases the flexibility, versatility, productivity, resource efficiency & usability of industrial production. It focuses on connectivity as a key enabler for cyber-physical production systems. Industry 4.0 factories require no cables; they will all be wireless. Everything within a plant will be modular, mobile and flexible. To effectuate this, manufacturers need ultra-low latency, ultra-high reliability and a high level of security.

5. The other major trend (very much a companion of Industry 4.0) is 5G. It offers applications for machine-type communication and the Internet of Things (IoT). It provides ultra-reliable, low-latency communication and massive machine-type communication which enables completely new industrial applications: precisely what Industry 4.0 needs. 5G is the key enabler to lift Industry 4.0 to the next level.

6. Forecasts[3] indicate that 5G-enabled digitalization will, by 2026, produce $1.233 Trillion in revenue for information and communication technology entities. Manufacturing would produce 19% of that revenue, trailing only energy and utilities industries in those projections. However, the required *investment* for incorporation of 5G in manufacturing is much lower than for other sectors. This makes the deployment of 5G in manufacturing exceptionally productive. The most innovative Industry 4.0 use-cases demand levels of URLLC (Ultra-Reliable, Low-Latency Communication), eMBB (Enhanced Mobile Broadband) and mMTC (Massive Machine-Type Communication) that only 5G can offer. Current technologies (which were designed for consumer communications such as WiFi and Bluetooth) are <u>not</u> able to address the full demands of new and innovative Industry 4.0 applications. 5G will enable the deployment of Automated Guided Vehicles (AGVs); Motion control; Modular Production Units; Mobile Human-Machine-Interfaces (HMI); Augmented Reality, and Massive Wireless Sensor Networks, to name just a few urgent applications.

7. These new industrial applications call for ultra-high reliability, with communication service availability on the order of 99.9999% of the time; ultra-low latency, with end-to-end transmission latency less than one millisecond; high device synchronicity of less than one microsecond; and seamless integration with Industrial Ethernet solutions. With respect to safety and security, no compromises are permissible. Security solutions must be tailored and optimized

[3] *Source: Ericsson & Arthur D. Little, 2017*

for each industry. 5G can meet these specific demands. However, this is true only if enough spectrum and network resources are available for Industry 4.0 applications. Therefore, there is a need to authorize private, local 5G networks in addition to 5G commercial mobile service available to the general public.

8. Traditional public 5G networks can support some Industry 4.0 applications. However, limiting 5G deployment to only commercial service providers would substantially limit the benefits that 5G can bring to the manufacturing process. Private, local 5G networks need not substitute for nor detract from commercial 5G service provided to individuals and other business entities. Instead, private, local 5G networks aim to create innovative alternatives for industrial markets in order to increase the effectiveness, flexibility and efficiency of spectrum use.

9. The "traditional spectrum usage model" limiting broadband delivery to commercial mobile service providers is, in the majority of cases, intended to address the needs of consumer electronics. Industry 4.0 has different and considerably more demanding network and spectrum needs. The following table shows some differences between consumer broadband needs and those of industrial applications. These differences are some of the reasons why private, local 5G networks are needed for Industry 4.0 applications.

| **Criteria** | **Consumer Broadband** | **Industrial Broadband** |
|---|---|---|
| # of Use Cases | Few | Many |
| Major Requirements | High Data Rates | Low Latency & High Reliability |
| Typical Traffic Pattern | Asymmetric (more DL than UL) | Symmetric (cyclic traffic) |
| Required Coverage | Everywhere / Nationwide | Local |
| Propagation Channels | Home / Office | Strong Multipath + Interference |

| | | |
|---|---|---|
| Impact of Network Outage | Annoying | Serious / Critical / Expensive |

There are valid business reasons for reliance by manufacturers on private, local 5G networks. First of all, deployment of a network within a manufacturing plant currently requires a significant investment. This is done now using one particular commercial broadband provider. Once this investment is made, the manufacturer becomes subject to and dependent on that specific service provider's business priorities, which are not always identical to those of the manufacturer. With private, local 5G networks, plant owners are able to allocate spectrum resources as needed at any point in time and in any geographical location according to production needs, independent of third party service providers.

10. Furthermore, having private, local 5G networks will open new business models and boost competitiveness in the market. To the extent that 5G is an enabler of innovative Industry 4.0 applications, a key goal is to make more efficient, responsive, and effective the way products are produced. In the context of Industry 4.0, 5G is an enabler. Private, local 5G networks create a "level playing field" among manufacturing competitors, allowing equal opportunity for deployment of Industry 4.0 applications independent of location and 5G commercial network buildout timelines. This is particularly critical for plants in rural areas that face the greatest risk of delays in 5G network roll-out. Permitting this autonomy enables quality of service based on the specific needs of the manufacturer.

11. Liability issues in manufacturing are of significant concern. Manufacturers are aware that significant damage may arise from network problems that will halt the entire production process. Consumer markets can tolerate periodic reductions in quality of service (QoS) and even minor shutdowns (e.g., online videos stopping momentarily). In the industrial domain, however,

one minor QoS decrease often means the stopping of the entire manufacturing process. Third party service providers are normally not responsible for the costs and losses associated with production shutdowns. It is highly problematic, therefore, for manufacturers to have no ability to control such a critical process. Where the manufacturer is not in full control of the network, there is a high risk of production problems and significant ambiguity in terms of responsibility for network outages. Consequently, liability issues could become a major obstacle to the full deployment of 5G in the manufacturing domain. Industry 4.0 requires manufacturer control over equipment, security mechanisms, algorithms and data protection measures. It also requires full control over the data from and access to sensors and actuators. Private, local 5G networks will provide factory owners with full control over safety, privacy and security, helping to avoid costly and cumbersome liability issues.

12. Mid-band spectrum is key to this process. The 3.7-4.2 GHz band offers optimal radio propagation conditions to meet the needs of Industry 4.0 applications in high ambient radio frequency noise environments. Other frequency ranges are suitable for some Industry 4.0 applications but not for all. For example, millimeter wave bands allow for localization and high throughput over very short path distances, but do not support propagation of radio waves through buildings and over the distance of a whole factory. In general, other bands are complementary to 3.7-4.2 GHz, but not a replacement therefor.[4] The mid-band is the technical "sweet spot" for comprehensive Industry 4.0 realization.

[4] Though the Commission is presently studying flexible use of the band 5.925-7.125 GHz (the "6 GHz band") in Docket 18-295, that band is not suitable for private, local 5G networks. While the 3.7-4.2 GHz band presently accommodates fixed incumbent services, and hence readily allows coordination of localized private 5G networks, the 6 GHz band currently accommodates an extensive variety of mobile incumbent services, including electronic news gathering (i.e. TV Pickup) for broadcasters at 6425-6525 MHz and 6875-7125 MHz and a variety of both mobile and aeronautical mobile video production in those segments. This incumbent operation would preclude any effective frequency coordination that would be necessary to allow introduction of private local 5G networks as an overlay. Broadcast auxiliary operation in these two segments of the 6 GHz band is increasing regularly as the result of overcrowding in the other, lower frequency BAS TV pickup bands at 2 GHz and 2.5 GHz.

**III. Private, Local 5G Networks Are Spectrum-Compatible With Fixed Satellite Service Incumbents.**

13. Private, local 5G networks, unlike commercial mobile networks, can be effectively and compatibly coordinated in the same spectrum with incumbent C-Band receive only Earth stations registered in the Commission's database, premised on geographic separation.[5] *There is no need or request for any reserved, exclusive or set-aside spectrum for private, local 5G networks.* They are, if coordinated in advance, entirely compatible with Fixed Satellite Service (FSS) downlinks, due to the localized nature of private, local 5G deployments; the strong signal attenuation of the private, local 5G networks provided by buildings at manufacturing facilities; the low field strength levels[6] at the edge of manufacturing facilities or "campuses"; and the limited required distance separation from FSS downlink antennas necessary in order to protect incumbents. Bosch urges therefore that private, local 5G networks be permitted to be operated in localized geographic area deployments, on a non- interference basis, premised on a prior coordination notice procedure relative to incumbent FSS and fixed service licensees. Such would allow private, local 5G networks to be deployed compatibly and efficiently on a licensed, or licensed-by-rule basis within manufacturing facilities at the local level.

14. A prior coordination notification process (similar to that used under Rule Parts 74 and 101[7] now, relative to FSS and point-to-point microwave facilities and relative to Broadcast

[5] This assumes that the Commission does not decide to auction the entire 3.7-4.2 GHz band to commercial mobile broadband service providers, but rather divides the band between incumbent FSS uses and commercial mobile service providers. Bosch proposes that private, local 5G networks be permitted in the subband permitted for incumbent FSS uses pursuant to the Prior Coordination Notice (PCN) process described herein. Proposals in the record in this proceeding support frequency division of the band between mobile service providers and incumbent FSS users. Private, local 5G networks require at least 100 megahertz of available spectrum at a given location, but again, this need not be exclusive-use.

[6] Studies in Europe indicate that the expected field strength of a private, local 5G network at the outer edge of a manufacturing campus would be between 55 dBµV/m/50 MHz and 70 dBµV/m/50 MHz. See paragraph 17, *infra*. At this power level, given the highly unlikely case of a manufacturing facility being located in the boresight of a nearby C-Band receive-only antenna, the minimum separation distance between the two need not be significant.

[7] See, 47 C.F.R. § 101.103(d) and 47 C.F.R. § 74.502(d).

Auxiliary fixed facilities in bands shared with other Part 74 and Part 101 licensees[8]) is the least intrusive, most flexible and easily implementable means of allowing private, local 5G networks as a compatible overlay. The Commission now has a current, accurate and complete registration database of protected C-band satellite receive-only antennas, with locations of those antennas specifically known. The field strength at the border of the manufacturing facility or campus is determinable and measurable, as is the separation distance necessary to achieve predicted compatibility to nearby incumbent FSS downlink antennas, in any given installation. The relatively localized nature of private, local 5G networks allows the facilities to be integrated in spectrum used by FSS downlink facilities successfully, without constraining either service.

**IV. The Deployment of Private, Local 5G Networks in Europe and Japan is Instructive**

15. The Radio Spectrum Policy Group (RSPG) of the European Commission (EU Commission) established a strategic roadmap for 5G in 2016 when it adopted and published its first *Opinion on spectrum related aspects for next-generation wireless systems (5G)*[9]. The RSPG in 2016 focused on identifying the building blocks needed for a rapid launch of new wireless services in next generation wireless systems. The frequency band 3.4-3.8 GHz (3400-3800 MHz) was identified as the first primary band for 5G, able to bring the necessary capacity for new 5G services. RSPG published on January 30, 2019 the *RSPG Opinion on 5G implementation*

[8] This process elegantly facilitates geographic sharing with ubiquitous, incumbent FSS receive-only antennas. It allows, for example, a new or upgraded manufacturing facility which will incorporate a private, local 5G network to notify all registered C-Band antenna users within a fixed radius of the proposed factory of its intention to implement such a network in advance of that implementation. The notification would specify the technical parameters of the radio frequency portion of the proposed network. The FSS downlink antenna users so notified would then have an opportunity to raise interference concerns, if any, and those can be resolved by negotiation between the parties involved and by implementing technical solutions. The manufacturing facility would, following completion of the PCN process, be licensed, either individually or licensed-by-rule, with the location of the manufacturing facility specified in a database for future reference and coordination by later-established C-Band downlinks or later-established private, local 5G networks.

[9] See, http://rspg-spectrum.eu/wp-content/uploads/2013/05/RPSG16-032-Opinion_5G.pdf

*challenges*[10]. This so-called *RSPG 3rd Opinion on 5G* addresses the need to ensure connectivity for vertical industries such as manufacturing (i.e. Industry 4.0). In particular, the EU Commission foresaw the use of "dedicated spectrum for verticals" in order to satisfy existing needs. The RSPG noted that connectivity for vertical industries could be provided by mobile operators' solutions, third-party service providers, and directly by verticals themselves in EU harmonized bands or in dedicated spectrum for verticals. The RSPG also recommended that member states consider other spectrum solutions including dedicated or shared spectrum for the business sector needs ("verticals needs") that may not be met by mobile service providers. Such solutions could take advantage of economies of scale and ecosystem availability in spectrum bands with EU harmonized technical conditions.

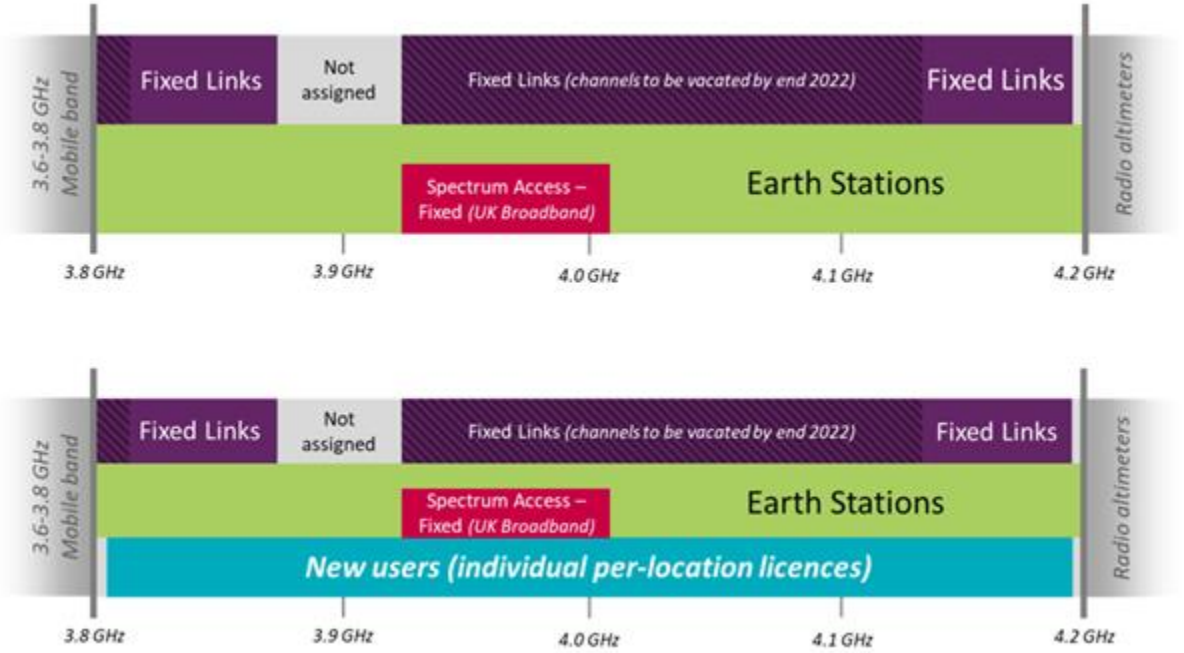
16. Three European examples of current regulatory initiatives implementing private, local 5G networks offer support for the concept that is applicable in the United States. First of all, in the United Kingdom (UK), OFCOM proposes to make spectrum available in a range of frequency bands (3.8-4.2 GHz among them) on a shared basis. OFCOM aims to encourage the development of new uses which will benefit both businesses and consumers. Allowing shared access to the 3.8-4.2 GHz band could support deployment of local networks in sectors including the industrial Internet of Things (IoT), enterprise, logistics, mining and agriculture, as well as helping to improve 5G in areas poorly served by commercial providers. These proposals were the subject of public consultation in the UK through March of this year[11]. This OFCOM initiative complements its proposal to award national licenses for the 700 MHz band and 3.6-3.8 GHz mobile spectrum by auction. OFCOM anticipates finalizing its proposal for shared spectrum

[10] See, http://rspg-spectrum.eu/wp-content/uploads/2013/05/RSPG19-007final-3rd_opinion_on_5G.pdf
[11] See, https://www.ofcom.org.uk/__data/assets/pdf_file/0022/130747/Enabling-opportunities-for-innovation.pdf

access by the second quarter of 2019 and it intends to issue licenses for local 5G use during the second half of 2019.

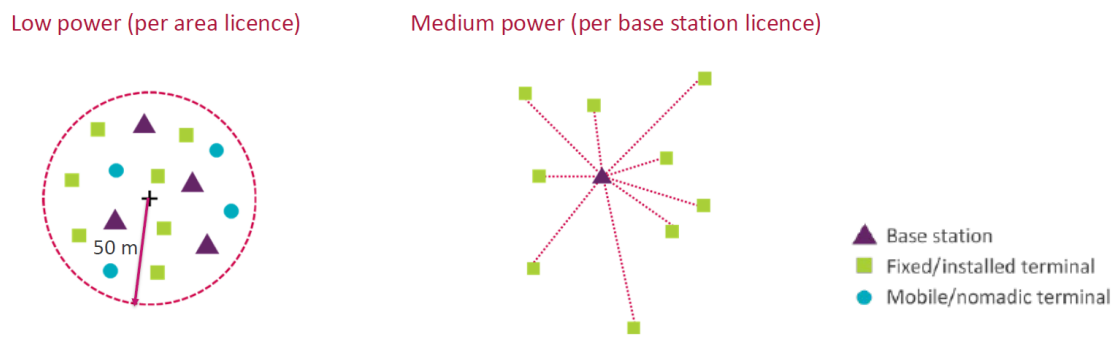
17. OFCOM proposes to allow shared access to 3.8-4.2 GHz and other bands that support mobile technology, which are adjacent to bands which have been made available, or are being considered for, nationwide commercial mobile use. The band 3.8-4.2 GHz is currently used by satellite Earth stations, point-to-point fixed links and fixed wireless access applications by UK Broadband. Deployments in the band are technically coordinated by OFCOM on a first-come, first-served basis. The band could be used for private networks that automate processes in a range of industries and more broadly support IoT. It is adjacent to the 3.4-3.8 GHz band, which has been identified as a primary 5G band in Europe. 5G technology standards cover this band and radio chipsets can be calibrated to support 5G deployments specific subranges from 3.4-4.2 GHz. Several countries – including the UK, Germany, Sweden, and Japan – are considering making 3.4-3.8 GHz available for localized 5G private networks:

**Figure 1: Diagram showing existing (top) and proposed (bottom) band plan for 3.8-4.2 GHz in the UK**

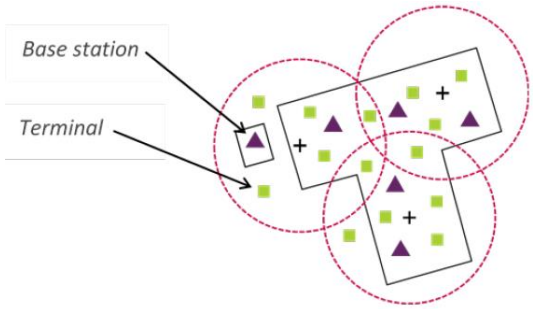


OFCOM proposes a common approach for users to access these bands. Companies will apply to OFCOM for a license for a specific location. For each license application, OFCOM assesses interference to and from other licensees in the band, based on specific coordination parameters and methodology. Assignments will be made on a first come, first served basis with regard to other users in the band (both new and incumbent). This provides a simple way for users to access spectrum where they need it, with a choice of bands to suit their needs and with certainty in spectrum access and quality of service.

OFCOM proposes two types of licenses to address different types of potential uses:




An example of how low power (local area licenses) would cover a manufacturing facility is shown in the following figure:




Coverage of this site, comprising a main building and a small outbuilding, requires three points to be registered.

Base station
Fixed/installed terminal
Mobile/nomadic terminal

The OFCOM proposals for shared access to the 3.8-4.2 GHz include specific technical parameters and conditions. The proposal is for the use of a range of unpaired channel sizes

(compatible with 3GPP standards), up to 100 MHz in bandwidth, on a technology neutral basis for Time Division Duplex (TDD) operation. Technical operating specifications include, among others, in-block power limits applicable to low power base stations, medium power base stations and terminal stations; antenna height for outdoor deployments limited to 10 meters; no limitation in antenna heights for indoor applications; and specific frame structure requirements and out-of-block emission limits.

18. The German Federal Network Agency (BNetzA) has taken an innovative approach to allocate the 3.4-3.8 GHz band for 5G: 3.4-3.7 GHz is to be auctioned on a nationwide basis to Mobile Network Operators (MNO); and 3.7-3.8 GHz is to be used on a local basis by individual companies. This approach aims to bring the full potential of 5G to vertical sectors (e.g. Industry 4.0) as well as to ensure an effective and efficient use of the radio spectrum. The proposal from the German government has been subject to various public consultations between 2017 and 2019. The results of the latest consultation[12] indicate the intention of the regulator to start granting local spectrum licenses during the second half of 2019. A final description of the spectrum use framework, including technical conditions, will be published by the German regulator also during the second half of 2019. However, the BNetzA already describes the "basic framework conditions" as the outcome of their latest consultation. A non-exhaustive selection of the most relevant conditions is as follows:

- Spectrum allocations in 3.7-3.8 GHz are exclusively allowed for local use (e.g. manufacturing plants and industrial campuses). The granting of spectrum licenses for local use is linked to a specific piece of land and its owner/user. It is also possible that several property owners, e.g. of an industrial park, could have a joint application for a frequency assignment for the entire area they occupy.

[12] See, https://www.bundesnetzagentur.de/SharedDocs/Downloads/DE/Sachgebiete/Telekommunikation/Unternehmen_Institutionen/Frequenzen/OffentlicheNetze/RegionaleNetze/20190311GrundlegendeRahmenbedingungen_pdf.pdf?__blob=publicationFile&v=1 (available only in German)

- Spectrum licenses for local use are subject to justifications for the amount of 5G spectrum applied for, to ensure efficient use of spectrum.

- Existing fixed satellite downlinks at 3.7-3.8 MHz must be protected.

- The interference mitigation mechanism proposed by the BNetzA is a maximum field strength at the boundaries of a piece of land. The license holder is able to flexibly deploy private, local 5G networks within the premises on the condition that the field strength at the boundary of the property is sufficiently low that it does not create harmful interference to incumbents in that band. The field strength at the property line initially proposed by the BNetzA was 55 dBµV/m/50 MHz. However, it is also considering limits of 60-70 dBµV/m/50 MHz. Different limit values for synchronized and non-synchronized networks are also under consideration.

- Use of the requested spectrum must occur within one year after the grant, or it will be withdrawn.

- It is anticipated that granted authorizations for local spectrum will be public, to enable network planning and protection of incumbent networks.

- BNetzA foresees certain administrative fees for the grant of licenses for local spectrum. These fees have not yet been determined.

19. The Swedish regulator (PTS) is considering the granting of "local permits" for the use of the frequency band 3.7-3.8 GHz on a local basis. For this reason, PTS launched a public consultation[13] between February and March of this year to learn about stakeholder needs. An excerpt (with translation) of this consultation reads as follows:

> PTS intends to carry out an allocation of frequency space in the 2.3 and 3.5 GHz bands. PTS is targeting to also assign the frequency space 3.7-3.8 GHz for local permits. Regarding the local permits, investigations are underway aimed at satisfying the need for local permits in the best way.

[13] See, https://pts.se/sv/dokument/remisser/radio/2019/konsultation-av-forslag-infor-tilldelningen-i-23-och-35-ghz-banden (only in Swedish)

20. The Japanese Ministry of Internal Affairs and Communications (MIC) plans to allocate 200 MHz (i.e. 4.6-4.8 GHz) for private, local 5G Networks.[14] Local 5G systems will support private network users' requirements and specialized needs from industry which may not be supported by MNO services. The rationale for this configuration is that local, private 5G systems provide flexible deployments not achievable with service provided exclusively by commercial mobile providers. In Japan, the 5G Mobile Communication System (5G NR) must be used. Small scale deployments in local regions are envisioned, and individual station licenses must be obtained. Local 5G bands are not to be used for MNO's coverage or service area obligations. However, local 5G service providers may use MNO's service for compensation.

21. Japan has developed and has preliminarily taken affirmative steps toward private, local 5G networks in a very short time indeed. A new working group (Local 5G WG) was established in Japan's MIC in December of 2018. The Bands 28.2 – 28.3 GHz and 2575 – 2595 MHz were discussed first (so-called Phase 1). The proposed policy for local 5G spectrum has been approved. It will imminently be published as part of the public consultation process. Policy development is expected to be completed by June 2019. It is expected that the corresponding regulation for Phase 1 will be implemented by August or September 2019. Other bands, such as 4.6 – 4.8 GHz and 28.3 – 29.1 GHz, will be discussed later (so-called Phase 2). The target for final regulatory approvals for Phase 2 will be June of 2020.

22. Local 5G spectrum can be used in Japan within private property (indoor and outdoor). Private premises do not necessarily have to be owned private property. Lenders for property owners may also deploy local private 5G networks. Transmission power may be adjusted at the time of the radio license application to ensure compatibility with other local 5G network users.

[14] See, http://search.e-gov.go.jp/servlet/Public?CLASSNAME=PCMMSTDETAIL&id=145209292&Mode=0 (only in Japanese). The band to be made available for commercial mobile network operators is 3.6 – 4.1 GHz. Also available in Japan for private 5G network use will be the band 28.2 – 29.1 GHz.

23. These developments in Europe and Japan highlight the rapid acceleration towards the deployment of private, local 5G networks, and illustrate that it is imperative for the United States to take steps to enable similar availability of these networks in order to ensure continued leadership in the race to 5G.

24. Bosch and the Supporting Parties have demonstrated herein that there are distinct, and yet widespread benefits to American manufacturing from the establishment of private, local 5G networks serving factories and manufacturing facilities here. These private local networks can easily coexist with incumbent FSS receive-only Earth stations without any dedicated spectrum at all, using the same prior coordination notice procedures now in place for fixed, point-to-point microwave licensing, minor geographic separation, and with some basic, yet flexible operating parameters, which are capable of calculation. Countries around the world are well along in facilitating private, local 5G networks in their 5G spectrum planning. The same accommodations should be made here in the interests of the advancement of American manufacturing and ensuring competitiveness domestically and worldwide.

Therefore, the foregoing considered, Bosch and the Supporting Parties again respectfully request that the Commission make 5G technology available on a flexible,

coordinated basis for private, local 5G networks in the band 3.7-3.8 GHz for use in support of Industry 4.0 applications as proposed herein.

Respectfully submitted,

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May 29, 2019